CLAIMS

What is claimed is:

1. A spin valve comprising:
   a) an antiferromagnetic layer;
   b) a ferromagnetic pinned layer having a magnetization pinned by the antiferromagnetic layer;
   c) a ferromagnetic free layer;
   d) a nonmagnetic spacer layer located between the free layer and the pinned layer such that the pinned layer controls a magnetization of the free layer; and
   e) a first underlayer in proximity of the free layer;

   wherein the first underlayer comprises an oxygen-rich nickel oxide.

2. The spin valve of claim 1, wherein the first underlayer has a first oxygen content sufficient to raise a magnetoresistive ratio ($\Delta R/R$) of the spin valve to between about 7% and about 9%.

3. The spin valve of claim 1, wherein the content of oxygen in the first underlayer is between about 55 atomic% and about 65 atomic%.

4. The spin valve of claim 1, wherein the thickness of the first underlayer is between about 20Å (2nm) and about 400Å (40nm).

5. The spin valve of claim 1, further comprising a second nickel oxide underlayer adjacent to the first underlayer.

6. The spin valve of claim 5, wherein the second nickel oxide underlayer is an oxygen-rich nickel oxide underlayer.

7. The spin valve of claim 6, wherein the content of oxygen in the first underlayer is different from the content of oxygen in the second nickel oxide underlayer.

8. The spin valve of claim 7, wherein the content of oxygen in the second nickel oxide underlayer is between about 50 atomic% and about 60 atomic%.

9. The spin valve of claim 6, wherein the combined thickness of the first underlayer and the second nickel oxide underlayer is between about 20Å (2nm) and about 400Å (40nm).

10. The spin valve of claim 6, wherein the first underlayer has a first oxygen content and the second nickel oxide underlayer has a second oxygen content sufficient to raise the magnetoresistive ratio ($\Delta R/R$) of the spin valve to between about 7% and about 9%.

11. The spin valve of claim 6, wherein the first underlayer has a first oxygen content and the second nickel oxide underlayer has a second oxygen content sufficient to balance the magnetoresistive ratio $\Delta R/R$ and pinning strength H_{ua}.

12. The spin valve of claim 11, wherein the $\Delta R/R$ ratio is between about 7% and about 9%, and the value of H_{ua} is between about 800 Oe and about 400 Oe correspondingly.

13. A method for making a spin valve having oxygen-rich nickel oxide underlayers comprising:

a) providing a substrate;
b) sputtering a Ni target on the substrate in a sputtering atmosphere consisting substantially of pure oxygen and an inert gas, whereby a first nickel oxide underlayer is over-oxidized;
c) depositing a ferromagnetic free layer on the first nickel oxide underlayer;
d) depositing a spacer layer on the free layer;
e) depositing a ferromagnetic pinned layer on the spacer layer; and
f) depositing an antiferromagnetic layer on the pinned layer.

14. The method of claim 13, wherein the inert gas is argon gas.

15. The method of claim 14, wherein the oxygen/argon ratio is greater than 1:10.

16. The method of claim 14, wherein the first nickel oxide underlayer comprises substantially more than 50 atomic% of oxygen.

17. The method of claim 13 further comprising:
sputtering a Ni target on the first nickel oxide underlayer in a sputtering atmosphere consisting substantially of pure oxygen and an inert gas, whereby a second nickel oxide underlayer is over-oxidized.

18. The method of claim 17, wherein the inert gas is argon gas.

19. The method of claim 18, wherein the oxygen/argon ratio is greater than 1:10.

20. The method of claim 19, wherein the total pressure of the sputtering atmosphere is reduced during the second nickel oxide underlayer formation to below 2mTorr.

21. The method of claim 20, wherein the second nickel oxide underlayer comprises substantially greater than 50 atomic% of oxygen.

22. A disk drive system comprising a read/write head containing a spin valve, wherein the spin valve includes:

a) an antiferromagnetic layer;

b) a ferromagnetic pinned layer having a magnetization pinned by the antiferromagnetic layer;

c) a ferromagnetic free layer;

d) a nonmagnetic spacer layer located between the free layer and the pinned layer such that the pinned layer controls a magnetization of the free layer; and

e) a first underlayer in proximity of the free layer;

wherein the first underlayer comprises an oxygen-rich nickel oxide.

23. The disk drive system of claim 22, wherein the first underlayer has a first oxygen content sufficient to raise a magnetoresistive ratio ($\Delta R/R$) of the spin valve to between about 7% and about 9%.

24. The disk drive system of claim 22, wherein the content of oxygen in the first underlayer is between about 55 atomic% and about 65 atomic%.

25. The disk drive system of claim 22, wherein the thickness of the first underlayer is between about 20Å (2nm) and about 400Å (40nm).

26. The disk drive system of claim 22, wherein the spin valve further comprises a second nickel oxide underlayer adjacent to the first underlayer.

27. The disk drive system of claim 26, wherein the second nickel oxide underlayer is an oxygen-rich nickel oxide underlayer.

28. The disk drive system of claim 27, wherein the content of oxygen in the first underlayer is different from the content of oxygen in the second nickel oxide underlayer.

29. The disk drive system of claim 28, wherein the content of oxygen in the second nickel oxide underlayer is between about 50 atomic% and about 60 atomic%.

30. The disk drive system of claim 27, wherein the combined thickness of the first underlayer and the second nickel oxide underlayer is between about 20Å (2nm) and about 400Å (40nm).

31. The disk drive system of claim 27, wherein the first underlayer has a first oxygen content and the second nickel oxide underlayer has a second oxygen content sufficient to raise magnetoresistive ratio ($\Delta R/R$) of the spin valve to between about 7% and about 9%.

32. The disk drive system of claim 27, wherein the first underlayer has a first oxygen content and the second nickel oxide underlayer has a second oxygen content sufficient to balance the $\Delta R/R$ ratio and pinning strength H_{ua}.

33. The disk drive system of claim 32, wherein the $\Delta R/R$ ratio is between about 7% and about 9%, and the value of H_{ua} is between about 800 Oe and about 400 Oe correspondingly.